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Committee on Science
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Mr. Chairman and members of the Subcommittee, it is an honor to appear before you today to discuss the Fiscal Year (FY) 2002 budget request for the U.S. Environmental Protection Agency's (EPA) Office of Research and Development (ORD), and to share with you some important and exciting accomplishments of our research program. ORD continues to be focused solidly on providing the highest quality science in support of EPA's mission to protect human health and to safeguard the natural environment.

INTRODUCTION

ORD's research in support of the Agency's key priorities of clean air, clean water, healthy children, healthy ecosystems, and partnerships with stakeholders provides the highlights for the budget request that we will discuss today. ORD is uniquely positioned to provide this support because of our ability to integrate interdisciplinary expertise in environmental and human health effects and exposure, risk assessment and risk management. No other research organization is designed or mandated to conduct a balanced and carefully-targeted interdisciplinary research program that addresses such key environmental topics as particulate matter and air toxics, safe drinking water, advanced integrated ecosystem monitoring and analyses, and contains research initiatives to protect the health of our children and others. ORD is the principal scientific and research arm of the EPA and supports the Agency's unique mission of protecting both human health and the natural environment. Through conscientious organizational development and detailed programmatic planning, ORD continues to conduct leading-edge research and to foster the sound use of science and technology in environmental decisions.

ORD's total budget request for FY 2002 is \$535 million and 1935 work years, which represents roughly 78% of the Agency's Science and Technology request, a slight increase over the 2001 President's budget, and we expect to maintain our momentum on critical environmental research. With these resources we will maintain partnerships with stakeholders in both the public and private sector in order to better align and leverage our investments.

STRENGTHENING SCIENCE THROUGH ORGANIZATIONAL IMPROVEMENT

ORD's National Laboratories and research portfolio are aligned along the Risk Assessment/Risk Management paradigm. The "risk paradigm" is an important Agency organizing principle. It consists of two interrelated phases, risk assessment and risk management. Risk assessment is the process used to evaluate the degree and probability of harm to human health and the environment from such stressors as pollution or habitat loss. It entails evaluation of potential effects, pathways and levels of exposure and culminates with characterization of risk under various scenarios. Risk management research involves development and evaluation of technologies for preventing or reducing risk. Our research activities are also balanced across the two broad categories of problem-driven research (to solve environmental problems of high risk and high scientific uncertainty) and core research (to improve the underlying scientific tools for understanding and protecting human health and the environment). We have recently completed an organizational and programmatic re-alignment to respond to a number of recommendations from external advisors regarding ways to strengthen EPA science. Our updated ORD Strategic Plan (at www.epa.gov/ord/SP) sets a solid platform for ORD's direction and serves as a roadmap for how we will work to more efficiently and effectively support EPA's mission. The new plan does not address research priorities, which are determined by a comprehensive Agency-wide planning process.

Five key strategic goals are outlined in the Plan along with specific actions we will take to achieve them:

- \$ support EPA's mission (to protect human health and safeguard the natural environment) by providing high-quality, relevant, responsive, and timely science
- \$ be a high-performing organization; continuously improve the efficiency and effectiveness of our organization and infrastructure
- \$ be a leader in the broader environmental research community; participate in scientific meetings, serve on professional committees, contribute to scientific debate, and play a leading role in shaping a national environmental agenda
- \$ integrate environmental science and technology to solve environmental problems; synthesize the broadest range of cutting-edge science and engineering into a comprehensive set of insights and an understanding of the increasingly complex environmental problems that we face
- \$ anticipate future environmental problems, before adverse effects materialize, to better inform our research planning and prioritization process.

Our strategic plan is the result of a comprehensive process that included: a series of workshops with internal and external stakeholders to gather advice and input; full participation by ORD's work force in developing objectives and actions; a thorough review by EPA customers and external stakeholders; and consultation with both ORD's Board of Scientific Counselors and EPA's Science Advisory Board.

By planning our FY2002 research program within the structure of EPA's Strategic Plan,

we are ensuring that ORD's research program solidly supports EPA's program and regional offices. During our formal annual planning process, ORD actively seeks input on Agency priorities and our research program activities from Agency staff and senior management. This assures that ORD plans needed credible, relevant, and timely research results and technical support that is designed to inform EPA policy decisions.

Increased Focus on Multi-Year Planning

Multi-year research plans will serve as a tool to better plan and coordinate the direction of our research program within ORD, across the Agency, and with others. In 2001-2002, ORD will complete its first comprehensive set of multi-year research plans (MYPs) with a 5 to 10 year time frame. The Government Performance and Results Act's (GPRA) structure of goals and objectives served as a useful starting point while giving us milestones to monitor our performance (long term goals, annual performance goals and annual performance measures). The MYPs are a logical framework for integrating research across GPRA goals and are intended to both have more time-dependent detail than ORD's issue-specific research strategies and plans and to link with our annual plans, showing how we intend to meet our out-year goals. The MYPs provide a basis for more readily creating annual plans and a context to perceive how decisions made in annual planning impact the ability of ORD to meet future goals and outcomes. They also improve ORD's comprehension of the impact of Agency priorities and budget guidance, and allow for a more thorough understanding of changes needed to emphasize a new research direction or accelerate an existing research effort. Since integration and collaboration across scientific disciplines and goals will be increased by providing an understanding of where similar work is needed and by broadly communicating possibilities for collaboration at all levels within ORD, cross-ORD Laboratory and Center integration is fostered. Finally, MYPs will improve Agency accountability by projecting work outcomes (annual performance goals), outputs (annual performance measures), and developing quantifiable measures of ORD's performance.

While research strategies describe the approach to addressing scientific questions, research plans focus on where a laboratory/center can best use its resources to develop science-based results. Our peer-reviewed research strategies and plans provide the direction for our research programs. We have completed nine research strategies and plans, the latest of which are the Mercury Research Strategy and the Environmental Risks to Children Research Strategy. Additional strategies and plans are under development. I have attached to this statement a list of our completed and draft research strategies and plans. (Final plans and external review drafts are posted on ORD's Home Page on the World Wide Web at www.epa.gov/ord/). By developing these peer-reviewed strategies and plans, we are confident that we have a comprehensive research program that addresses today's most pressing environmental issues. Taken together, our accomplishments, current work, and strategies for future research point to a sound, relevant, and forward-looking environmental research program that solidly supports ORD's and the Agency's strategic goals. This then is the background against which we present our FY 2002 research program.

EXAMPLES OF RECENT ORD SCIENTIFIC ACCOMPLISHMENTS

The following highlights provide examples of some of our recent contributions to the Agency. These showcase ORD's guiding principles of excellence, relevance, timeliness and leadership in meeting the scientific challenges of environmental and human health protection as well as striving for leading-edge science and engineering in support of environmental decision-making. These accomplishments also provide the context for discussing our FY2002 budget proposal.

Airborne Particulate Matter

ORD has been a catalyst for stimulating research and data collection to understand the nature and effects of small particles in the air. By identifying Airborne Particulate Matter (PM) research needs, establishing five PM Research Centers, and compiling a database of research being carried out inside and outside EPA, the Agency is advancing the understanding of PM health effects by drawing on the expertise of some of the nation's leading researchers. Over 570 projects were described in the comprehensive PM research database, and reflects EPA and other agencies' alignment with National Research Council (NRC, 1998) long-term recommendations. The NRC's follow-ups since have reported that we are already well on track with their recommended focus areas. In response to a 1997 Presidential directive, ORD has developed a greatly expanded and coordinated interagency PM research program with other Federal agencies. This program is fulfilling the directive's charges of contributing to an expansion of the science associated with PM health effects, as well as developing improved monitoring methods and cost-effective mitigation strategies. The upcoming Air Quality Criteria Document (AQCD), an update of the state-of-science, is based upon thousands of studies, many of which were funded or stimulated through EPA efforts. The Criteria Document is to be peer reviewed by the Clean Air Scientific Advisory Committee in July and will serve as the scientific basis for the review of the National Ambient Air Quality Standards (NAAQS). EPA continues to support the five university-based PM Centers, focused on work in the relationship of specific components of PM to both short- and long-term human health effects. In addition, further development of the Federal Reference Method for use by States in compliance measurements will ensure the integrity of monitoring data.

EPA's 1997 PM risk estimates, which were peer-reviewed by the SAB, suggested tens of thousands of early deaths per year, with many more cases of illness in susceptible populations. ORD is leading the research effort to further our understanding of which parts of PM (e.g., size, chemical composition) pose the greatest health risks to specific populations. For example, ORD's health effects studies show that PM affect heart rate variability, a known factor in heart attacks in elderly people. In addition, exposure studies of elderly people show a relationship between measured ambient outdoor concentrations and actual personal exposure, a key finding that buttresses earlier epidemiologic evidence. The mechanism(s) of toxicity remains unclear, but several PM components are linked with biological toxicity. ORD is setting the stage for future mandated re-evaluations of health-based standards as well as providing tools to implement current and future standards with research in: atmospheric modeling, emissions characterization, source apportionment, and control strategies.

Understanding and Protecting Coastal Ecosystems

Because estuaries and other coastal waters are critical for wildlife habitat, commercial fisheries, and recreational enjoyment, ORD is focusing on understanding their condition, trends in their condition, and how they can be protected. Rapid population growth, coastline development, increases in agricultural fertilization and in the density of farm animals, and atmospheric inputs all factor into development of this understanding. Multiple non-point sources of environmental pollutants and stressors significantly impact coastal ecological integrity leading to impacts on public health and biological resources such as fish and shellfish. A successful federal/state partnership with 24 states and Puerto Rico has resulted in the development of a baseline data set of US coastal condition for estuaries. The National Coastal Assessment has melded state and regional needs with ORD skills and research. This partnership has resulted in a National Coastal Condition Report and monitoring designs for the streams and coastal ecosystems of most states.

Surveys conducted by ORD from 1990-1996 show that US coastal ecosystems rank no better than fair with regard to ecological condition, and estuaries are rated poor in coastal wetland loss, sediment contamination, coastal eutrophication, and biotic condition. ORD's work in coastal monitoring has established the use of benthic communities as a surrogate for biotic conditions and the relation of benthic conditions to sediment contamination and coastal eutrophication. Surveys are being conducted in all coastal states and Puerto Rico during 2000-2001. Because no consistent survey data prior to 2000 exists, these surveys will establish baseline trend data on the condition of coastal estuaries. This baseline trend data will be a yardstick by which the benefits/results of environmental decision making and environmental programs for coastal ecosystems can be measured.

Assessing the Effects of Climate Change

ORD's Global Change Research Program is assessment oriented, with an emphasis on understanding the potential consequences of global change. This program focuses on the implications of global change and should not be confused with efforts to evaluate control technologies or propose solutions to mitigate change. The Global Change Research Act of 1990 established the U.S. Global Change Research Program (USGCRP, a coalition of 10 Federal Agencies) to provide scientific information to decision makers as they plan whether and how to respond to the risks and opportunities presented by global change. ORD is a member of the USGCRP and is responsible for regional and sectoral assessments as part of the periodic assessment of the consequences of global change for the United States.

ORD's Global Change Research Program emphasizes understanding the potential consequences of global change for four focus areas: 1) Human Health - assessing the consequences of global change on weather-related morbidity, vector- and water-borne diseases, and on the health consequences associated with particulate matter and ozone under global change; 2) Air Quality - examining the potential consequences of global change on tropospheric ozone and particulate matter; 3) Water Quality - assessing the possible impacts of global change

on water pollutants and microbial pathogens, drinking water, and biocriteria; 4) Ecosystems - Evaluating the effects of global change on aquatic ecosystems, invasive species, and ecosystem services. These assessment activities address topics that represent the greatest risks to people and their environment, have demonstrated policy relevance, and show promise for extending the research community's assessment capabilities.

Global changes, climate change and variability, change in land-use patterns, and change in UV radiation, occur both on a regional and global scale. ORD and its academic partners contributed to the first national assessment and the synthesis report: "Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change, 2000". Additional National Assessment publications supported by ORD include: "Preparing for a Changing Climate: The Potential Consequences of Climate Variability and Change Mid-Atlantic Overview, March 2000"; "Climate Change in the Upper Great Lakes Region: A Workshop Report, May 1998"; "Global Climate Change and Its Consequences on the Gulf Coast Region of the United States, 1999", and "The Potential Health Impacts of Climate Variability and Change in the United States, May 2000".

Drinking Water Contaminants

While chemical disinfection of public water systems has controlled major risks from waterborne microbial diseases, it can create hundreds of compounds known as disinfection by-products (DBPs) which raise other public health concerns. ORD scientists have greatly advanced our understanding of these by-products. To better understand the health risks posed by drinking water contaminants, ORD has developed critical new information on DBP health effects, methods for detection and removal techniques. Contamination of water supplies with waterborne pathogens continues to pose public health risks when treatment is inadequate. Local water systems are using new methods developed by ORD to detect *Cryptosporidium* and *Giardia*, which have been responsible for a number of waterborne disease outbreaks the U.S. and elsewhere. An increasingly important part of ORD's drinking water research program is focused on unregulated chemicals and microbes on the Contaminant Candidate List (CCL). Considerable progress has already been made in the areas of analytical methods development, health effects and treatment technology development for selected high priority CCL contaminants.

In conjunction with the American Water Works Association Research Foundation and the Association of California Water Agencies, ORD has secured an impressive amount of information on arsenic. ORD research has shown that arsenic can be metabolized in the human gut, and that various factors, such as the amount of selenium in the diet, influence how arsenic is metabolized and eliminated. These insights are being used to develop a model of arsenic behavior in humans. In addition to research at the cellular level, ORD scientists have studied its health effects in populations in the United States and elsewhere in the world. ORD conducted a study in several Utah communities that historically have had long-term exposure to arsenic in drinking water. This study showed that it is feasible to conduct an epidemiologic study of waterborne exposure to arsenic in the United States in which effects seen in studies of non-U.S. populations (e.g., skin and bladder cancer) can be evaluated.

Because one chemical form of arsenic (arsenate) is easier to remove from drinking water, it is necessary to determine how much of each species is present before devising a treatment strategy. ORD researchers successfully developed a sensitive method to measure both of these forms (arsenite and arsenate) at very low concentrations. ORD scientists evaluated two innovative treatment processes to remove arsenic from drinking water: ion exchange with brine (salt solution) recycle and iron coagulation with microfiltration. ORD-sponsored research at the University of Houston developed more cost-effective and efficient use of the ion exchange removal process. Both processes were very cost effective for removing arsenic and practical for small systems.

Understanding Children's Exposures and Risks

ORD has led the effort to understand how our young children are exposed to pesticides and other potentially harmful chemicals. Children are more at risk from pesticides than most adults since pound for pound of body weight, children breathe more, eat more, and have a more rapid metabolism than adults. Because they are growing and developing, toxic substances can have a major impact on the way children's biological systems work. An indirect route of children's exposure to pesticides is through contact with chemicals brought into the home from the workplace (via contaminated clothing or skin). Children may be more directly exposed to pesticides by playing on floors and lawns where pesticides are applied. ORD has developed methods to understand this route of exposure and has incorporated this new understanding into human exposure models that, for the first time, account for both the variability and the uncertainties found in such exposures. We are testing our understanding and theories through field observational programs to measure the children's exposures in homes and day-care centers. The Children's Health program will continue with its two overarching research categories (Asthma and Non-Asthma Science) under the Agency's Children's Health program. These efforts focus on: age-related exposures; physiology; biological responses that may result in increased risks; and research in risk reduction methods. This research aims to provide the scientific underpinnings that will result in better EPA risk assessments for children and may ultimately reduce risks from potential environmental health threats. The eight existing Children's Health Research Centers, operated in collaboration with the National Institute of Environmental Health Sciences (NIEHS), are scheduled to end in 2002. A new Request for Applications has been published, with the intent of creating four new centers in 2002 that focus on developmental effects in children. These new centers will be supported at about \$1.5 Million per year per center with funding to be shared between EPA and NIEHS. In FY02, the Children's Centers will continue to focus on understanding the causes of environmentally-induced disease among children and on the eventual decrease the prevalence of childhood disease. Their efforts are focused on childhood asthma and other children's respiratory diseases, growth and development, and children's exposure and susceptibility to pesticides. The Centers are also investigating community-based risk reduction methods to lower children's exposures to environmental agents and improve their health outcomes.

We believe that the Children's Centers funded jointly by the STAR program and by NIEHS have been very successful. While these Centers are only part way through the period of their grants, much is already being accomplished. For example, the Children's Center at the

University of Washington has: 1) discovered that the enzymes that humans use for detoxifying certain pesticides are not uniformly distributed among people, 2) children below the age of 12 months do not have this enzyme, and, 3) about 20% of Hispanic farm workers have low levels of this enzyme. These findings have significant implications for defining populations that may be particularly susceptible to pesticide exposures. As was extensively featured in a feature article in the science section of Tuesday's New York Times, the Children's Center at Columbia University in New York has found that sensitization to indoor allergens occurs early in life B perhaps even in utero. The Children's Center at the University of Michigan has been extremely successful in involving many community groups in Detroit in their research on asthma. This comprehensive (African American, Hispanic, Community, and worker groups) involvement has included: 1) participation in the design of the study, 2) recruiting study participants, 3) taking samples, 4) participating in investigators meetings. Individuals from these groups have received training in the implementation of the study, and some are now paid Afield@employees.

EPA-WIDE INVENTORY OF SCIENCE ACTIVITIES

EPA is committed to continuing, expanding, and improving its *EPA-Wide Inventory of Science Activities*. On October 17, 2000, the EPA Science Policy Council (SPC), Chaired by the Deputy Administrator, directed Agency staff to expand and enhance the *Science Inventory*.

This year, EPA is compiling the *Science Inventory* in the Peer Review Product Tracking system, a searchable electronic database that EPA has used for the past three years to track the peer review of scientific and technical work products used in Agency decisions. By conducting the *Science Inventory* through the annual peer review data call and housing it within the Peer Review Product Tracking database, the new Inventory will be more comprehensive and detailed, and B most importantly B more useful as an important tool for the any or all of the following uses:

- \$ developing cross-cutting strategic science plans;
- \$ promoting and enhancing science collaboration across the Agency;
- \$ identifying areas where science consolidation and streamlining can occur and duplication can be avoided; and
- \$ identifying technical gaps to be filled.

One specific use of the *Science Inventory* will be for the completion of EPA's *Contaminated Sediments Science Plan*. The sediments plan, developed under the auspices of the SPC, will be the first Agency-wide strategic plan for a cross-cutting science issue. We expect to complete the sediments plan by December of this year. The *Science Inventory*, by cataloging the wide range of sediments-related science being conducted across EPA, will play an important role in completing this ground-breaking plan.

The *Science Inventory* responds directly to the National Research Council's

recommendation in *Strengthening Science at the U.S. Environmental Protection Agency* that EPA expand its science inventory activities, as well as its recommendation that EPA improve how it disseminates and explains the significance of ORD's research products and ongoing activities. The *Science Inventory* will enhance scientific communication and collaboration within the Agency, and improve public access to and understanding of EPA's diverse environmental science program.

ENHANCING ENVIRONMENTAL SCIENCE THROUGH PARTNERSHIPS, POSTDOCTORALS, GRANTS AND FELLOWSHIPS

ORD leverages the Nation's scientific resources by partnering with other Federal Agencies on the Committee on Environment and Natural Resources (CENR) and through our Science to Achieve Results (STAR) grants which supports the efforts of scientists in universities and not-for-profit organizations. Our FY02 Presidential Budget request includes \$100 million for grants and \$10 million for STAR fellowships. Our partnerships attempt to ensure that all external work complements and strengthens our in-house research. Partnering with Federal Agencies provides a common sense and cost-effective way for us to utilize the special expertise residing outside of our Agency, focusing on Agency research issues where possible, while also reducing overlapping and duplicative work. Two good examples of these cooperative enterprises are our Children's Health Centers with NIEHS, and our Ecology and Oceanography of Harmful Algal Blooms program with NOAA, the National Science Foundation, and the Office of Naval Research.

ORD's post-doctoral program, begun in 1999 as a three year effort to enhance EPA's scientific workforce, has provided a constant stream of highly trained Postdoctoral candidates (> postdocs=) who bring state of the science training to ORD. Scientific and engineering postdocs brings a fresh perspectives and new skills to our intramural research program and contribute to work in critically important areas such as human exposure modeling in particulate matter and ecological risk assessment. In addition, the program enables EPA to improve workforce diversity and assists with succession planning. By the end of this year, over one hundred postdocs will be on board with many of our original group effectively competing for permanent positions inside and outside of ORD. The quality of these candidates and their contributions to the Agency's science has surpassed our expectations. We intend to maintain a total of 150 postdocs, backfilling in for those that completed or leave the program.

ORD's Science to Achieve Results (STAR) grants program is planned in tandem with our in-house research program to ensure that the Nation's needs for superior environmental science is met in a cost effective manner. The STAR program funds research grants and graduate fellowships in numerous environmental science and engineering disciplines through a competitive solicitation process. ORD has strived to ensure that opportunities to compete for the grants are available to numerous institutions including Historically Black Colleges and Universities (HBCUs) and Hispanic Serving Institutions (HSIs). The STAR program awards about \$100M annually and currently has 1,000 active research grants and fellowships. Consistent with legal requirements, STAR grants are intended to advance scientific knowledge in important environmental areas and also provide an excellent base for EPA to build its own

research program. STAR grants attempt to stimulate the creativity of our colleagues outside of the Agency. The program aims to expand the nation's expertise by recruiting the best environmental scientists and engineers from the academic and private sector through a variety of competitive grants, investigator-initiated exploratory research grants, graduate fellowships, and environmental research centers.

The GAO reported in September 2000 that although STAR program funding falls within EPA's strategic goals and STAR grants align with ORD and program office priorities, the program needed to improve tracking of grant results and better communicate grant results with program offices. In response to these GAO comments, ORD has begun aggressive management enhancements which we will continue to implement in FY02. Since its inception in 1995, STAR has greatly expanded its partnerships with other organizations involved in scientific research of mutual interest. STAR has worked with numerous federal and private sector partners, allowing leveraging of EPA's funds. At present, STAR has awarded over 1,100 grants to institutions in 49 states and Guam, Puerto Rico, and the District of Columbia. This has allowed us to develop broader, more comprehensive programs that leverage resources and provide prompt and efficient results. Some of the other organizations that have partnered with ORD in STAR RFAs include: National Science Foundation, United States Department of Agriculture, National Air and Space Administration, National Ocean and Atmospheric Administration, Department Of Energy, National Institute of Environmental Health Science, Department Of Interior, American Water Works Association Research Foundation, and Association of California Water Authorities.

EPA'S FY 2002 SCIENCE AND TECHNOLOGY BUDGET

The Agency's total FY 2002 request in the Science and Technology (S&T) account is \$641 million and 2417 total work years, a decrease of \$34 million and 47 work years from FY 2001. The S&T account, created in 1996, funds the operating programs of the Office of Research and Development, the Office of Air and Radiation's Office of Transportation and Air Quality, and the Program Office laboratories. These organizations provide significant scientific, engineering, and technical expertise in meeting the Agency's broad array of environmental goals. The S&T account allows the Agency to utilize a variety of skills and expertise, regardless of their organizational location.

ORD's total FY 2002 request is \$535 million and 1935 work years. Of this total, ORD's FY 2002 request in the S&T account is \$497 million and 1823 work years. The remaining \$38 million and 112 work years are in accounts other than the S&T account to support the Superfund, Leaking Underground Storage Tanks, and Oil Spills research programs. This budget supports critical research and development activities in 8 of 10 Agency strategic goals.

The President's FY 2002 request reflects the Administration's continued commitment to pursuing sound science at EPA. The Agency's statutory responsibilities are bound closely to scientific knowledge of human health and environmental problems, and it is therefore critical that research and scientific assessment be integrated with EPA's policy and regulatory activities. In addition, the increasingly complex issues facing the Agency necessitate a high-quality, integrated research program in order to develop sound scientific bases for its decisions. Key

Administration research priorities in the FY 2002 request for EPA include:

- \$ **Particulate Matter B** Current data on chronic health effects from PM exposure are very limited, yet available data indicate that these effects are substantial. In 2002, EPA is devoting resources to support PM chronic epidemiology research, for which we are now able to include the full measurement of the range of atmospheric pollutants, to evaluate the role of chronic PM and co-pollutant exposure in producing death and disease, and to assess the most prominent PM health risks.
- \$ **Drinking Water Research B** The Safe Drinking Water Act Amendments of 1996 require EPA to publish a list of unregulated contaminants to aid in priority setting for the Agency's drinking water program. The current Contaminant Candidate List (CCL) categorizes 60 chemicals and microbes where additional research in the areas of health effects, occurrence/exposure analytical methods and/or treatment is necessary to provide a sound scientific basis for regulatory decision making.
- \$ **Global Change Research B** Continuing work to support EPA's Global Change Research Program will enable us to focus on integrated human health and ecosystem assessments, on topics like the potential spread of vector-borne and water-borne disease. Integrated assessments focus on the interactions of multiple stressors and their combined effects. The four priority areas for these assessments remain human health, air quality, water quality, and ecosystem health (including wildlife and biodiversity).

Our FY 2002 budget request builds upon ORD's significant accomplishments, supports the Agency's mission, and provides the scientific and technical information that is essential for EPA to achieve its long-term goals. The research and development program outlined in our budget request reflects both ORD's highly effective in-house research program, and our efforts to partner and work with other research organizations. Our resources are spread over eight of the ten Agency strategic goals, focusing on core science issues that cross environmental media and on more specific problem-oriented research. I would like to briefly highlight ORD's planned research contributions to each of these eight goals.

Goal 1 B Clean Air. EPA's particulate matter (PM) research program provides the scientific basis for the review and implementation of PM National Ambient Air Quality Standards (NAAQS). In addition to consulting with the National Academy of Science, the Agency continues to work closely with other Federal research organizations, academia, and the private sector to implement a research program consistent with NAS recommendations. Consistent with these recommendations, the Agency will continue its emphasis on PM epidemiology research to evaluate the role of chronic PM and co-pollutant exposure in causing death and disease. In addition, the Agency is expanding research efforts on how to attain the NAAQS for PM.

The Agency will also continue its tropospheric ozone research in the areas of atmospheric sciences and risk management. EPA's air toxics research will focus on urban toxics, fuel/fuel additives, and low-emitting vehicles to improve the knowledge underpinning

decisions required by the Clean Air Act on residual risk, area sources, and mobile sources. EPA will emphasize research relating ambient concentration of air toxics to actual human exposure and on the risks posed from exposures to pollutant mixtures. ORD's active program in air toxics takes advantage of PM-related efforts. We are developing neighborhood-scale air quality modeling, undertaking personal exposure monitoring to aid in model development, increasing IRIS assessment, examining the effects of priority air toxics and air toxics mixtures, and developing more accurate estimates of air toxics emissions for mobile sources. Indirect (ingestion, dermal) exposure may contribute significantly to the residual risk of some pollutants. Work is continuing on refining total exposure modeling approaches for indirect exposures.

Goal 2 B Clean & Safe Water. In support of the Safe Drinking Water Act priorities, EPA's drinking water research program will continue to evaluate the nature and magnitude of waterborne diseases, conduct research on sensitive sub-populations, and develop analytical detection methods for contaminants of regulatory interest. In 2002, the Drinking Water Research program will continue to develop and improve methods to detect and measure microbes (e.g., CCL-related microbes), field-test methods and collect exploratory occurrence data for worst-case source waters or vulnerable drinking water systems, and develop and apply methods to detect and measure human exposure to microbes. Additional health effects and exposure studies on arsenic will be conducted to evaluate the dose-response relationships at low doses for effects such as cancer, cardiovascular disease, and other toxic endpoints. A primary focus of drinking water risk management research is determining the treatability of microbial and chemical contaminants on the CCL, and determining cost-effective approaches for maintaining water quality in drinking water distribution systems.

Aquatic stressors research will continue to focus on the development of methods and models for determining total maximum daily loads (TMDLs), on the risks posed by chemical pollutants to wildlife, and on the development of more cost effective technologies and approaches for managing contaminated sediments. Research is continuing to determine the nature and extent of the risk associated with nutrient loadings leading to eutrophic conditions, hypoxia and increased frequency of harmful algal blooms. EPA will also continue to develop and validate effective watershed management strategies for controlling high volume and toxic Wet Weather Flows, and develop effective evaluation tools to aid timely and informed decisions on beach advisories and closures. In FY 2002, the beaches research program will develop monitoring and risk communication alternatives in order to provide water quality managers with tools to make timely and informed decisions on beach advisories. A new emphasis will be placed on watershed restoration research for the development of decision support tools to assist watershed managers in analyzing problems and identifying cost effective solutions. This activity will help to provide the scientific underpinning of TMDLs. New research will develop the scientific basis to support the development of criteria for suspended solids and sediments (excessive siltation is among the most frequently identified causes of water quality impairments) and will develop and evaluate more cost effective technologies and approaches for their management. Research is continuing on the

development of diagnostic tools to help identify the causes of water quality impairments. EPA is developing and validating effective watershed management strategies and tools for controlling wet weather flows, especially when they are toxic. Watershed management research will investigate techniques to reuse and reclaim stormwater for beneficial purposes, defining the conditions when secondary uses are both desirable and economically possible. Research will continue to address critical data gaps regarding the growing human health and environmental concerns of microbial pathogens in surface waters.

Goal 3 -- Safe Food. The Food Quality Protection Act (FQPA) mandates a single, health-based standard for all pesticides in all foods and provides for special protections for infants and children. The Act identifies clear science needs consistent with evaluating potential pesticide exposure pathways and effects, and the need to review more complex factors (such as cumulative exposure and effects, and multiple routes of exposure). In FY 2002 the Agency will continue to focus on developing new and improved test methods to evaluate the effects of environmental exposure to pesticides and other chemicals in sensitive subpopulations. Work will continue to address uncertainties regarding intermittent exposure by developing data, methods, and models for characterizing and combining exposures and assessing exposure-dose-response relationships for pesticides with different exposure patterns, with an emphasis on developing a foundation for a cumulative risk assessment methodology. The Agency will continue efforts to develop a systematic approach for determining the cumulative risk for a given set of exposure conditions. Understanding the cumulative risks associated with exposure to pesticides and toxic chemicals will provide the foundation for improved regulatory decisions.

Goal 4 B Preventing Pollution and Reducing Risk. Research will continue to support the development and improvement of methods to evaluate hazards on human health endpoints, models to improve the biological basis for human health risk assessment, and methods to identify ecological hazards, predict ecological risk, and characterize environmental stressor interactions. In FY 2002, ORD will continue its multi-Agency effort with the National Cancer Institute (NCI), the National Institute for Environmental Health Sciences (NIEHS), and the National Institute of Occupational Safety and Health (NIOSH), in support of the Agricultural Health Study (AHS), which is an examination of the health of men and women in agriculture. Data collection for the study is scheduled to be completed in FY 2002; sample analysis will be completed and data analysis initiated in FY 2003; and reporting will be completed by FY 2004. EPA's role is to evaluate how accurately the study questionnaire classifies pesticide application activities and enables the prediction of applicator exposure and dose. Under the Children's Health program, research will address the need for methods to evaluate the special sensitivities of children to pesticides and other toxic substances. The methods are developed to evaluate endpoints of toxicity that are qualitatively/quantitatively different from those of concern for adults.

Goal 5 B Better Waste Management. The Superfund Innovative Technology Evaluation (SITE) Program continues to foster the development and use of lower cost

characterization technologies and innovative treatment techniques intended to solve difficult and complex site remediation problems and reduce the cost of clean up. Research includes studies on ecological samplers and biosensors for characterization along with evaluations of technologies dealing with priority remediation problems, such as contaminated sediments and brownfields redevelopment sites. Since the initiation of the SITE program in 1986, cleanup of contaminated sites through the use of innovative technologies has resulted in a total inflated cost savings of over 2.1 billion dollars (SITE Program Annual Report to Congress, 1999). Research on methyl tertiary butyl ether (MTBE), a fuel additive, includes a field evaluation of natural attenuation of MTBE in ground water with different hydrogeologic conditions. Studies on the biological processes that control the degradation of MTBE are also being conducted. Research on the remediation of dense, non-aqueous phase liquids (DNAPLs), a major source of organic groundwater contamination, includes studies on using geophysical techniques and thermal treatments for cleanup processes. In FY 2002, research will continue on characterization and containment evaluation of contaminated soils, sediments, and groundwater, and will develop methodologies and factors that more accurately quantify estimates of contaminants in soils. Work under this Objective will address priority remediation problems in order to reduce human and ecosystem exposure.

Efforts in waste management are focusing on improving multimedia science/modeling for the Hazardous Waste Identification Rule (HWIR). This ongoing research includes work on the Multimedia, Multi-pathway, and Multi-receptor Exposure and Risk Assessment (3MRA) methodology. The 3MRA modeling system (version 2 will be out in the Fall) and attendant databases will help determine which wastes can be safely released ("exit levels") from costly disposal requirements without posing risks of either human or ecological exposure.

EPA is also conducting research on the factors influencing the formation of dioxins and other products of incomplete combustion (PICs) as well as research on PIC measurement techniques. Work will also focus on emissions characterization and control research of toxic contaminants, such as furans and mercury, to reduce uncertainties related to waste combustion. In FY 2002, waste management research will continue to examine improved ways to manage solid and hazardous waste, including developing and evaluating more cost effective alternatives. Research includes work on bioreactors and how to minimize releases to the environment through air and groundwater will continue along with studies on the design and effectiveness of municipal waste containment units, including landfills.

Goal 6 B Reducing of Global and Cross-Border Environmental Risks. As part of the Second US Global Change Research Program (USGCRP) National Assessment, EPA will address key new assessment questions of concern. These issues were raised by stakeholders in the first national assessment. We will address these concerns by expanding efforts to assess the impact of global change on air quality and water quality and quantity, including work to understand the interactions between regional air quality and global change. This will partly be accomplished by interacting STAR Grant Research on global models with in-house efforts, using EPA's Models-3 to predict regional air quality as a result of global change.

Goal 7 B Quality Environmental Information. In FY 2002, the Agency's Risk Assessment Forum (RAF) will assist risk assessors by producing products which include: risk assessment guidelines, technical panel reports on special risk assessment issues, and peer consultation and peer review workshops addressing controversial risk assessment topics. The Integrated Risk Information System (IRIS), which provides EPA consensus health information, will continue to support the Agency, state and local governments, and the general public in making human health decisions and developing risk assessments and regulatory standards. As part of IRIS, ORD has committed to produce or update nine chemical assessments. In response to SAB comments, ORD is developing more detailed guidance on appropriate documentation of uncertainty and variability in health assessments. The guidance will include: ways to use data-driven uncertainty factors rather than default values; methods for examining curvilinearity or thresholds in dose-response relationships; means of integrating information from multiple relevant studies of adequate quality; and how to balance assessments of known human variability in susceptibility to various classes of chemical compounds.

Goal 8 B Sound Science. ORD's research investments in this Goal are arrayed across the following four long-term objectives:

Conduct Research for Ecosystem Assessment and Restoration. EPA's Environmental Monitoring and Assessment Program (EMAP), in cooperation with all 24 coastal states, interested tribes, and other Federal Agencies, is conducting the National Coastal Assessment to provide the EPA and Congress with the first integrated, comprehensive, and statistically valid national report card on the health of estuarine communities. Under the National Coastal Assessment, three states (California, Oregon, and Washington) have completed sampling while 19 states are in their second year of sampling and Hawaii and Alaska are in their first. EPA, in cooperation with Regions 8, 9, and 10, is also continuing to implement Western EMAP in order to demonstrate that monitoring tools developed for the Mid-Atlantic can be adapted to ecosystems in the western U.S. Other research includes methods and multi-media integrated models to identify the most significant environmental stresses and forecast how risk reduction alternatives improve or sustain biological and chemical water quality. EPA will continue to develop improved remote sensing techniques and landscape indicators to efficiently estimate and forecast ecological conditions and vulnerabilities. EPA is also developing restoration technologies which focus on: (1) rehabilitation of the structure of watershed ecosystems, (2) reduction of the stressor(s), and (3) enhancing the natural resilience of the system. EPA is maintaining its commitment to coastal and western states and is requesting continued full funding for the National Coastal Assessment and Western EMAP.

Improve Scientific Basis to Manage Environmental Hazards and Exposures This program supports the development of multimedia and multipathway exposure models and mechanistically-based data, tools and approaches to address uncertainties in human health risk assessment, with an emphasis on infants and children and other sensitive populations. The Children's Health program will continue its two overarching research categories—(asthma and non-asthma) efforts, to include: age-related exposures; physiology; biological responses that may result in increased risks; and research in risk

reduction methods. This research aims to provide the scientific underpinnings that will result in better EPA risk assessments for children and may ultimately reduce risks from potential environmental health threats. As previously described, the Children's Centers will continue their efforts on understanding the causes of environmentally-induced disease among children and to eventually decrease the prevalence of childhood disease.

Enhance Capabilities to Respond to Future Environmental Developments Efforts in this area will include developing new assays on endocrine disrupting chemicals (EDCs) for the Agency's endocrine disruptors screening and testing program and determine the magnitude of adverse impacts of EDCs on human health. We will also develop approaches for reducing exposures to EDCs from sediment, wastewater treatment outfalls, confined animal feeding operations, and combustion sources. The STAR program's efforts in this area in this objective includes the Exploratory Grants program, which, unlike issue-specific RFAs, provides opportunities for individual investigators from the academic research community to conceive, define, and propose research projects. Increased effort in the mercury research program will focus on the atmospheric transport, transformation, and fate of mercury from source to deposition point. This research will improve the Agency's understanding of problems posed by mercury releases into the environment. Providing relevant information and data will enhance EPA's ability to assess and manage mercury and methylmercury risks, thereby leading to improved human and ecological health.

Improve Environmental Systems Management EPA addresses human and environmental health issues through the development of pollution prevention tools and technologies for the industrial and other sectors. Research includes the enhancement of computerized databases on less-polluting alternatives and the development of decision tools for process simulation and chemical replacements. Environmental technologies are tested through the Environmental Technology Verification (ETV) Program to provide stakeholders with an independent and credible assessment of technologies for their consideration and decision making. ETV provides objective, high quality information on the performance of innovative, commercially ready environmental technology. This information is intended to reduce barriers to acceptance of higher performance technology and to promote more rapid adoption by decision makers and appropriate marketing of technological solutions to environmental problems. The ETV Program completed its five-year pilot phase in FY 2001 with over 100 technologies verified. Six of the twelve most successful ETV pilots will continue in FY 2002: advanced monitoring, air pollution control, greenhouse gas, drinking water systems, water protection, and pollution prevention. ORD expects to submit a report to Congress assessing the 5 year pilot program to Congress in the Fall. Reduced funding in FY2002 reflects our success in securing private sector cost sharing for technology verification testing, one of the ultimate goals of the Agency's ETV program.

CONCLUSION

In ending my testimony before you today, I would like to emphasize ORD's commitment

to not only provide the foundation for sound environmental decisions, but to assume the national leadership in producing the knowledge that will help us solve critical problems of the 21st Century. Sound science, on a foundation of rigorous peer review, remains a critical mainstay of our work. While conducting sound science is the foundation for our success, producing results in a timely fashion to solve problems is the measure of that success. Further, ORD's continuing innovations in the way we perform and manage research will optimize the delivery of results to our Agency customers, stakeholders, and the American people.

COMPLETED RESEARCH STRATEGIES AND PLANS

- \$ Action Plan for Beaches and Recreational Waters
- \$ Waste Research Strategy
- \$ Pollution Prevention Research Strategy
- \$ Ecological Research Strategy
- \$ Research Plan for Endocrine Disruptors
- \$ Research Plan for Arsenic in Drinking Water
- \$ Research Plan for Microbial Pathogens and Disinfection By-Products in Drinking Water
- \$ Mercury Research Strategy
- \$ Environmental Risks to Children Research Strategy

RESEARCH STRATEGIES AND PLANS IN DEVELOPMENT

- \$ Particulate Matter Research Strategy
- \$ Global Change Research Strategy
- \$ Human Health Risk Assessment Research Strategy
- \$ EMAP Research Strategy
- \$ Air Toxics Research Strategy
- \$ Drinking Water Contaminants Candidate List Research Plan
- \$ Comprehensive Drinking Water Research Strategy
- \$ Social Sciences
- \$ Asthma